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ORIGINAL RESEARCH

The mSQUASH is a feasible and valid measurement tool to uniformly assess daily physical activity in patients with rheumatic diseases

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ABSTRACT

Background The modified Short QUestionnaire to ASsess Health-enhancing physical activity (mSQUASH) was originally developed and validated in Dutch patients with axial spondyloarthritis (axSpA). To support world-wide distribution, applicability and comparability of measuring physical activity, our aim was to perform translation and cross-cultural adaptation of the mSQUASH into English, field testing in other rheumatic diseases and clinical validation in patients with axSpA.

Methods The Dutch mSQUASH was translated into English according to forward–backward Beaton protocol. Semistructured interviews were conducted in representative samples of patients with axSpA (n=13), Sjögren's disease (n=10), systemic lupus erythematosus (n=10) and giant cell arteritis/polymyalgia rheumatica (n=10) to verify relevance, comprehensiveness and comprehensibility. For construct validity (n=95), Spearman correlations were used with clinical outcome assessments. For test–retest reliability (n=82), intraclass correlation coefficients (ICC) were calculated. For responsiveness (n=80), standardised response means (SRM) were calculated stratified by Anchor method.

Results Translation and cross-cultural adaptation of the mSQUASH into English were successfully carried out, which can serve as basis for other translations. Only minor adaptations and clarifications were implemented. Fair correlations were found between mSQUASH and Axial Spondyloarthritis Disease Activity Score (ρ=−0.31), Bath Ankylosing Spondylitis Functional Index (ρ=−0.37) and Assessment of SpondyloArthritis International Society-Health Index (ρ=−0.30). Test–retest reliability was very good (ICC: 0.87). Responsiveness corresponded to the direction of self-reported changes in physical activity (SRM: 0.72 for improved, 0.06 for stable and −0.74 for worsened).

Conclusion The mSQUASH showed good linguistic and face validity according to field testing in different rheumatic diseases. Clinical validation confirmed good construct validity, test–retest reliability and responsiveness in patients with axSpA, which supports the use of the mSQUASH in clinical practice and research.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Regular physical activity plays an essential role in the management of rheumatic diseases, particularly in axial spondyloarthritis (axSpA), and contributes to overall health benefits according to the 2021 EULAR recommendations regarding lifestyle behaviours in rheumatic and musculoskeletal diseases. Physical activity can be measured with various instruments. The modified Short QUestionnaire to ASsess Health-enhancing physical activity (mSQUASH) is an easy applicable measurement instrument for daily clinical practice, which includes the amount and type of physical activity performed. The mSQUASH was developed and validated in patients with axSpA. However, it is expected that this questionnaire is more widely applicable and can also be used in patients with different rheumatic diseases.

WHAT THIS STUDY ADDS

⇒ Translation and cross-cultural adaptation of the mSQUASH into English was successfully carried out. The mSQUASH showed good linguistic and face validity according to field testing in English as well as in patients with Sjögren's disease, systemic lupus erythematosus and giant cell arteritis/polymyalgia rheumatica. Clinical validation confirmed good validity, test–retest reliability and responsiveness in axSpA, which supports the use of the mSQUASH in clinical practice and research.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Our study shows that the mSQUASH is a feasible and valid questionnaire to uniformly assess not only the amount but also the type of daily physical activity in patients with axSpA and other rheumatic diseases.

INTRODUCTION

Physical activity is an important aspect in the non-pharmacological management of

rheumatic and musculoskeletal diseases (RMDs).[1] In axial spondyloarthritis (axSpA), exercise is particularly important as it has the potential to effectively modify disease activity.[1] Previous studies in axSpA demonstrated that physical activity contributes to improved function, enhanced spinal mobility, reduced pain and stiffness, better cardiorespiratory function and improved overall well-being.[2–8] On the contrary, sedentary behaviour was found to be associated with lower quality of life.[7] However, excessive or inappropriate physical activity may exacerbate inflammation and increased pain,[9] underscoring the need for tailored physical activity plans.

To effectively incorporate physical activity into clinical practice and research, it is essential to have an easy applicable, valid and reliable measurement tool. The gold standard for measuring total energy expenditure is the doubly labelled water method. However, this is expensive, time-consuming and has a high patient burden, which is not feasible in daily clinical practice.[9] Alternatives like accelerometers and physical activity monitoring apps lack specification on the type and domains of physical activity, making it difficult to identify potential areas for improvement. Self-reported questionnaires are low in costs, have a low patient burden and capture specific activity types, making them more feasible for clinical practice.[9 10]

The modified Short Questionnaire to ASsess Health-enhancing physical activity (mSQUASH),[11] adapted from the SQUASH,[12] was preferred by axSpA patients over the International Physical Activity Questionnaire (IPAQ),[13] due to its concise format and clarity.[11 14] Furthermore, the mSQUASH demonstrated better criterion validity assessed with the accelerometer, better sensitivity to change and fewer missing values when compared with the IPAQ in axSpA.[11]

The original SQUASH was developed for the general Dutch adult population.[12] The adaptations leading to the mSQUASH included changes to the instructions, adjustments to the combination of response options to enhance interpretability, the incorporation of a 'not applicable' answer choice to minimise missing values and alterations in specific domains (ie, commute to other destinations, intensity of physical activity at work or school, shopping as leisure activity and physical therapy exercises as example in sports and exercise).[11 13] Since the adaptations of mSQUASH for axSpA were overall generic, we expect that the mSQUASH is more widely applicable and can be used in patients with different rheumatic diseases.[11 15 16]

To support world-wide distribution, applicability and comparability of measuring physical activity, our aim was to perform translation and cross-cultural adaptation of the mSQUASH into English, in combination with field testing in different rheumatic diseases, and to perform clinical validation of the mSQUASH in patients with axSpA.

METHODS

Patients

The axSpA study was conducted within 'The Natural History and Pathogenesis of Spondyloarthritis' cohort at the University of California, San Francisco (UCSF), USA. All patients included in the study were 18 years of age or older, were diagnosed with axSpA and met the 2009 Assessment of SpondyloArthritis International Society (ASAS) classification criteria for axSpA and had a wide range of patient and disease characteristics.

The field testing in other rheumatic diseases was conducted in the prospective observational cohort studies for patients with Sjögren's disease (SjD),[15] systemic lupus erythematosus (SLE)[16] and giant cell arteritis (GCA)/polymyalgia rheumatica (PMR)[17] at the University Medical Center Groningen (UMCG), the Netherlands. Patients were ≥18 years, clinically diagnosed with these diseases and showed a variety in patient and disease characteristics, representative for the specific disease population.

Exclusion criteria were severe comorbidities (such as neurologic or psychiatric problems), which would potentially affect their assessment of physical activity or patients not able to speak, read or write. All patients provided written informed consent according to the Declaration of Helsinki to participate in the study.

Modified Short QUestionnaire to ASsess Health-enhancing physical activity

The mSQUASH refers to the amount of physical activity in a normal week in the past month (online supplemental appendices 1 and 2). The questionnaire consists of 17 questions, which can be divided in four different domains: (1) commute to/from work or school and commute to/from other destinations, (2) work (paid/unpaid) or school/study, (3) household activities, (4) leisure activities and sports and exercise. For each question, patients are asked whether the question applies (if not, the not applicable box can be used), the number of days per week an activity was performed, the average time (hours and minutes) to perform an activity and how physical demanding each activity was. The physical demand can be divided in slow/light, moderate and fast/high.

The scores of the mSQUASH can be calculated using the syntax (online supplemental appendix 3). The scores per domain and the mSQUASH total activity score are calculated by multiplying the minutes per week with a demand factor of the activities performed. The demand factor ranges from 1 to 9 and is based on the Metabolic Equivalent of Task (MET) value of the Ainsworth's Compendium of Physical Activities[12] and the perceived physical demand reported by the patient. A higher score reflects a higher level of physical activity. The mSQUASH total activity score was excluded if the minutes per week of activity exceeded 6720.[11] This maximises physical activity to 16 hours per 24 hours making the assumption that respondents sleep or are inactive for at least 8 hours

per 24 hours. The mSQUASH manual includes a detailed guideline for data preparation, score calculation, results and interpretation (online supplemental appendix 3).

The translation, cross-cultural adaptation and clinical validation of the mSQUASH were performed in accordance with the protocol of the study of the ASAS-health index[18 19] and in line with the current international guidelines for these procedures.[20]

Translation and cross-cultural adaptation of the mSQUASH into English

The original mSQUASH, which was developed in Dutch, was translated and cross-culturally adapted into English using the forward–backward procedure according to the protocol of Beaton.[21] This procedure consists of five steps: forward translation (step 1), synthesis (step 2), backward translation (step 3), expert committee review (step 4) and field test with cognitive debriefing (step 5). A flowchart with more details of the translation process is shown in figure 1.

In step 1, two independent translators, who are native English speakers, produced translations. One translator had a clinical background and specific knowledge of axSpA concepts, while the other did not have a medical background. Both translators created written reports to document their translation decisions, including addressing any challenging phrases or uncertainties. This step covered the translation of instructions, questions and response options.

In step 2, the two forward English translations were used to create a synthesis of these translations. Consensus was reached among the translators. All decisions and issues resolved were documented in a written report.

In step 3, two independent backward translations were produced based on the synthesis of the forward translations. The backward translators were native English speakers who were not informed about the medical concepts being discussed and were blinded for the original Dutch mSQUASH. The backward translations were compared with the original version to identify any discrepancies and ensure the translated version maintains the same meaning and nuances as the original version.

Step 4 involves an expert committee that included all forward and backward translators, an axSpA expert rheumatologist and a methodologist. This committee reviewed all translations, including the two forward translations, synthesis, two backward translations and the corresponding written reports. Consensus was reached on discrepancies and decisions were made to achieve equivalence between the original Dutch mSQUASH and English mSQUASH. According to the protocol of Beaton *et al*, this process encompassed four key areas: semantic equivalence ('ensures that the words have the same meaning and there are no grammatical issues or multiple interpretations in the translation'), idiomatic equivalence ('focuses on translating colloquialisms or idioms, which may require creating a similar expression in the target language'), experiential equivalence ('checks if the translated items reflect an experience that is relevant and familiar in the target culture') and conceptual equivalence ('ensures that the concepts conveyed by the words are understood similarly across cultures')[21]

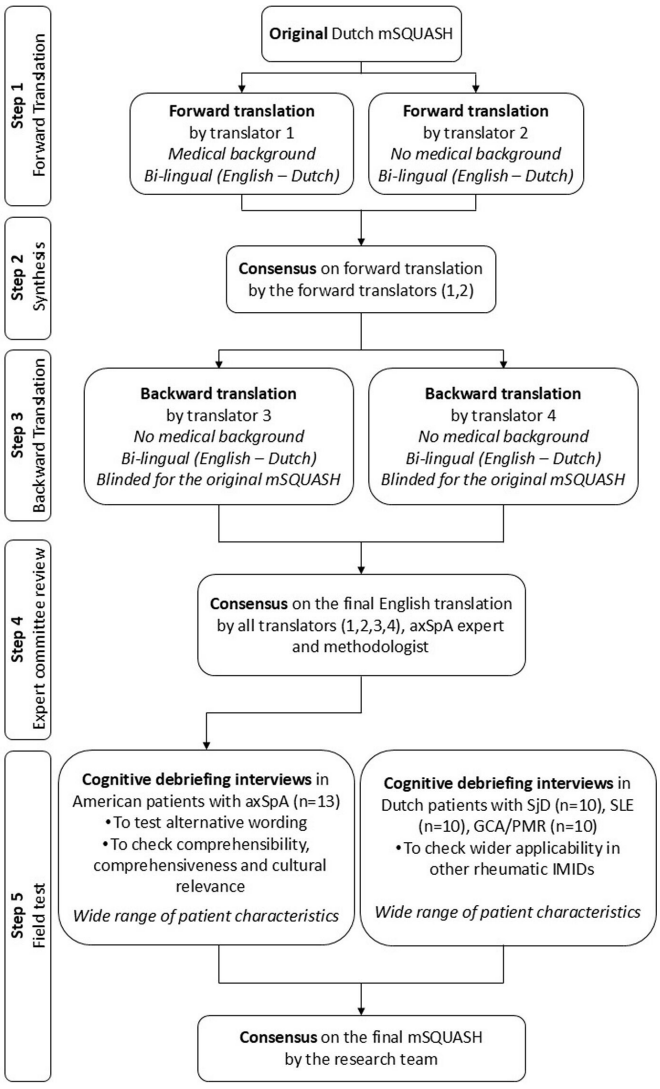

Figure 1 Flowchart of forward-backward procedure according to the protocol of Beaton. axSpA, axial spondyloarthritis; GCA, giant cell arteritis; mSQUASH, modified Short QUestionnaire to ASsess Health-enhancing physical activity; PMR, polymyalgia rheumatica; SLE, systemic lupus erythematosus, IMIDs, immune-mediated inflammatory diseases.

In step 5, two parallel studies were conducted: (1) field testing of the English version of the mSQUASH was conducted through semistructured, one-to-one interviews in patients with axSpA (minimum of n=10) at the UCSF for cross-cultural adaptation to check the understandability, interpretation and cultural relevance of the translation and (2) semistructured, one-to-one interviews were performed with the Dutch version of the mSQUASH in patients with SjD; n=10, SLE; n=10 and GCA/PMR; n=10 at the expertise centres of the UMCG. The latter focused on the

applicability of the questionnaire across different rheumatic diseases.

All interviews were guided by a cognitive debriefing guideline that covered all aspects of the assessment, allowing patients to provide their input both before and after the process. Patients were asked about the mSQUASH's relevance, comprehensiveness (no key concepts missing), and comprehensibility (instructions, response options, items appropriately worded, response options match the question). All interviews were audio recorded and transcribed verbatim. The data were coded and analysed through thematic analysis approach.[22] The results of the thematic analysis were discussed during a meeting with all interviewers (YvdK, NA, HK and MC) and the project leader (SA). The mSQUASH was adapted during a final consensus meeting with the research team (YvdK, AS, DP, LG, and SA), taking into consideration all suggestions from patients. Adaptations to the mSQUASH were made if: (1) it aligned with the purpose of measuring daily physical activity, (2) it was linguistically accurate, (3) it did not conflict with other suggested adaptations or the current content of the mSQUASH. In case multiple proposed adaptations covered similar topics, the most user-friendly adaptation was implemented.

Measurement properties

Construct validity

To evaluate the construct validity, it was investigated if the English mSQUASH demonstrates the anticipated pattern with regard to disease activity, physical function and overall functioning and health. Patients with axSpA were asked to complete the mSQUASH during their visit at the outpatient clinic and the clinical assessments were collected as standard part of the visit at the UCSF.

Disease activity was assessed using the Axial Spondyloarthritis Disease Activity Score (ASDAS) and Bath Ankylosing Spondylitis Disease Activity Index (BASDAI; range 0–10), physical functioning was assessed with the Bath Ankylosing Spondylitis Functional Index (BASFI; range 0–10), and overall functioning and health were evaluated using the ASAS Health Index (ASAS-HI; range 0–17).[19 23–25] We hypothesised that there would be fair to moderate correlations between the mSQUASH and the clinical outcome measures, as they assess related but different constructs, comparable to the original Dutch mSQUASH.[11]

Test–retest reliability

To evaluate the test–retest reliability, it was investigated if repeated assessments of the English mSQUASH generated comparable outcomes in patients with stable disease.[26] AxSpA patients with stable disease and no change in intervention completed the mSQUASH on two different occasions approximately 2 weeks apart, with a maximum of 3 weeks. Within this period, change in disease status is unlikely, but it is long enough to reduce the risk of recall bias. Patients with known physical activity changes, for example, due to holiday, were excluded from the reliability analysis. Reliability was evaluated for both total scores and activity scores per domain. We hypothesised that test–retest reliability would be good and comparable to the Dutch mSQUASH.[11]

Responsiveness

To evaluate responsiveness, it was investigated if the English mSQUASH was sensitive to change in patients with self-reported improvement, stability and worsening of physical activity. AxSpA patients starting biological DMARDs as well as patients with unchanged intervention completed the mSQUASH 3 months apart and patients were asked to rate if their physical activity was improved, stable or worsened compared with the first visit. It was hypothesised that standardised response mean (SRM) is positive in patients showing improved physical activity, close to zero in those with stable physical activity, and negative for those with worsened physical activity, comparable to the Dutch mSQUASH.[11]

Feasibility

The duration for completing the mSQUASH was documented. The final version of mSQUASH in English and Dutch, the questionnaire manual (including a list of sports and activity codes, SPSS syntax and additional information), as well as the SPSS mSQUASH database template, are provided at no additional costs.

Statistical analysis

Data analysis was performed with the use of IBM SPSS Statistics for Windows V.28.0.0 (IBM, Armonk, New York). Results were reported as: numbers of patients (%), mean (SD) or median (IQR presented as 25th and 75th percentile) for categorical, normally distributed and non-normally distributed variables, respectively.

For construct validity, Spearman's correlation coefficients were used to analyse the association between the mSQUASH and clinical assessments. Correlations of 0.0–0.2 were considered poor, 0.2–0.4 fair, 0.4–0.6 moderate, 0.6–0.8 good and >0.8 very good.[27]

For test–retest reliability, intraclass correlation coefficients (ICCs) between the first and second assessment were calculated for total activity scores and domain-specific activity scores using a two-way mixed effect model, single measures and absolute agreement. Reliability was considered good for ICC values ≥0.7. Additionally, Bland-Altman analysis was conducted on the total scores to evaluate systematic difference and to determine the 95% limits of agreement (LOA).

For responsiveness, the Anchor method was used for patients with self-reported improvement, stability and worsening of physical activity. For each group, the SRM was computed by dividing the mean change in scores between visits by the SD of the score changes. SRM values of <0.5 were considered small, 0.5–0.8 moderate and >0.8 large.[28]

RESULTS

Translation and cross-cultural adaptation of the mSQUASH into English

Step 1–4: translation process

Forward and backward translations were successfully carried out. The two forward translations yielded similar results. Minor discrepancies were discussed in the consensus meeting on the forward translation. All translations, including the two forward translations, synthesis, two backward translations and the corresponding written reports were discussed by the expert committee. Consensus was reached on minor discrepancies and decisions were made to achieve equivalence between the original Dutch mSQUASH and English mSQUASH. This resulted in a English version of the mSQUASH, which was used for the field testing in axSpA patients at UCSF. In addition, the Dutch version of the mSQUASH was used for the field testing in other rheumatic diseases at UMCG.

Step 5: field testing

A total of 10 patients per rheumatic disease group (axSpA, SjD, SLE and GCA/PMR) were interviewed, with a variety in patient and disease characteristics representative for the specific rheumatic disease. Characteristics of these patients are shown in online supplemental appendix tables 1–4. For axSpA, three extra patients were interviewed to enhance diversity in educational levels. For axSpA, 10 participants were interviewed face-to-face at UCSF and three interviews took place by videocall. For the other rheumatic diseases, all interviews were conducted face-to-face, except for one via videocall. No non-participants were present at the interviews.

All patients found the mSQUASH relevant and easy to complete. Based on suggestions for minor adaptations and clarifications, changes were made to the layout of the questionnaire instruction and the response choice 'not applicable' was moved to the right. The title of the domain 'other transport (to and from)' was changed into 'commute to/from other destinations' to avoid confusion with means of transport such as a car and the example 'visiting someone' was added. 'Physical activity at work or school' was changed into 'work (paid/unpaid) or school/study'. In the domain 'sports and exercise', 'dancing' was added as example. 'Handball' was replaced with 'soccer' and 'ice skating' was replaced with 'running' to make it more internationally applicable. The examples that were replaced have corresponding MET values. All examples represent a mix of low/high intensity, individual/team sports and physical therapy/endurance/ball sports. All the changes were also implemented in the Dutch mSQUASH (online supplemental appendix 2).

Measurement properties—clinical validation

In total, 95 patients with axSpA were included in the clinical validation study. For construct validity, all 95 patients were included. For test–retest reliability, 85 of the 95 patients met the inclusion criteria; three patients were excluded as they exceeded the upper protocol boundary of 16 active hours per day on the second assessment of the mSQUASH. For responsiveness, 80 of the 95 patients were included; five patients were excluded due to this same reason. There was no missing data. All patient characteristics of these subgroups are presented in table 1.

Table 1 Characteristics of the 95 patients with axSpA included in the clinical validation study

Age, years	45.8 (37.5–53.9)
Sex, male	67 (71%)
Classification r-axSpA	76 (80%)
HLA-B27 positive	83 (87%)
Symptom duration, years	22 (16–33)
Diagnosis duration, years	12 (8–21)
BMI, kg/m^2	24.5 (22.1–27.3)
bDMARD use	70 (74%)
NSAID use	36 (38%)
ASDAS	1.4 (0.9–2.1)
BASDAI, 0–10	1.6 (0.8–3.0)
CRP, mg/l	1.8 (1.0–3.0)
BASFI, 0–10	1.0 (0.2–3.3)
ASAS-HI, 0–17	3.0 (1.0–6.0)

Values are presented in: n (%) or median (IQR).
ASAS-HI, Assessment of SpondyloArthritis international Society Health Index; ASDAS, Axial Spondyloarthritis Disease Activity Score with CRP; BASDAI, Bath Ankylosing Spondylitis Disease Activity Index; BASFI, Bath Ankylosing Spondylitis Functional Index; bDMARD, biological disease-modifying anti-rheumatic drugs; BMI, body mass index; CRP, C reactive protein; HLA-B27, human leucocyte antigen B27; NSAID, non-steroidal anti-inflammatory drug; r-axSpA, radiographic axial spondyloarthritis.

Construct validity

As expected, fair correlations were found between mSQUASH total activity scores and ASDAS (ρ=−0.31, p<0.001), BASDAI (ρ=−0.25, p<0.05), BASFI (ρ=−0.37, p<0.001) and ASAS-HI (ρ=−0.30, p<0.001) (figure 2).

Test–retest reliability

Mean time between the two assessments of the mSQUASH was 2.1±0.6 weeks. The ICC for the mSQUASH total activity score was 0.87, showing very good reliability. The ICC for the different domains demonstrated a range from fair to very good reliability (table 2). The most activity was performed in the domain 'work or school/study activities', which showed the highest reliability (ICC: 0.95). The least activity was performed in the domain 'commute to/from work or school and commute to/from other destinations', which showed the lowest reliability (ICC: 0.42).

The Bland-Altman plot for the mSQUASH total activity score revealed a small mean difference (444) between the two assessments, which was not significantly different from zero (figure 3). This indicates that there was no systematic bias. The 95% LoAs were wide (5056; −4168),

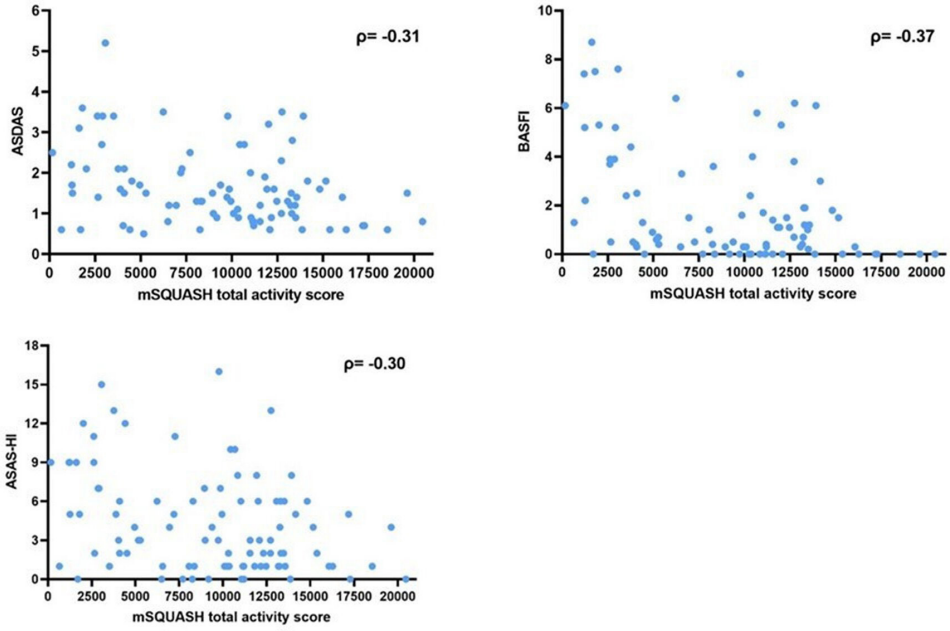

Figure 2 Construct validity: scatter plots of the association between mSQUASH total activity score and clinical assessments. mSQUASH, modified Short QUestionnaire to ASsess Health-enhancing physical activity.

showing that only large changes can be considered true changes at individual patient level.

Responsiveness

SRMs were moderate and corresponded to the direction of self-reported changes in physical activity after 3 months at group level. For the group of patients who reported improvement of physical activity (n=17), SRM was 0.72. For the group of patients who remained stable (n=44), SRM was close to zero (0.06). For the group of patients who reported worsening of physical activity (n=14), SRM was −0.74 (table 3).

Feasibility

Mean time to complete the mSQUASH was 4.8±2.0 min (n=43 of field testing). The final mSQUASH in English and Dutch, the mSQUASH questionnaire manual and the database template are provided in the supplementary files for reference and use (online supplemental appendices 1, 2, 3 and 5). The scoring of the mSQUASH relies on the syntax, which is most suitable for research purposes requiring detailed analysis of physical activity levels. The questionnaire itself provides insight into individual physical activity patterns, which is suitable for clinical practice.

DISCUSSION

This study provides the English version of the mSQUASH, which can be used in research and daily clinical practice and can serve as basis for translations in other languages. All patients evaluated the mSQUASH as relevant and easy to complete. Based on all cognitive debriefing interviews in different rheumatic diseases, some modifications were implemented in the layout and terminology of the mSQUASH. These adjustments were primarily clarifications. The overall structure and content of the mSQUASH remained unchanged. Minor adaptations that were made, addressed some cultural aspects identified during the interviews. For example, in the domain 'sports and exercise' sports examples were modified to ensure cultural inclusivity, making them universally

Table 2 Test–retest reliability: ICC of mSQUASH total activity score and different domains

	Baseline	2 weeks	ICC	95% CI
Total activity score	10203 (5251–13238)	10055 (6008–12655)	0.87*	0.80, 0.92
Commute work/school and other destinations	180 (40-600)	150 (0–458)	0.42*	0.21, 0.60
Work or school/study activities	7200 (0–7515)	7200 (0–8100)	0.95*	0.92, 0.97
Household activities	1155 (615–2520)	1005 (470–2306)	0.88*	0.80, 0.92
Leisure activities and sports and exercise	2040 (888–1985)	1725 (728–2690)	0.78*	0.67, 0.86

Values are presented in median (IQR).
*Statistically significant at p<0.05.
ICC, intraclass correlation coefficients; mSQUASH, modified-Short Questionnaire to ASsess Health-enhancing physical activity.

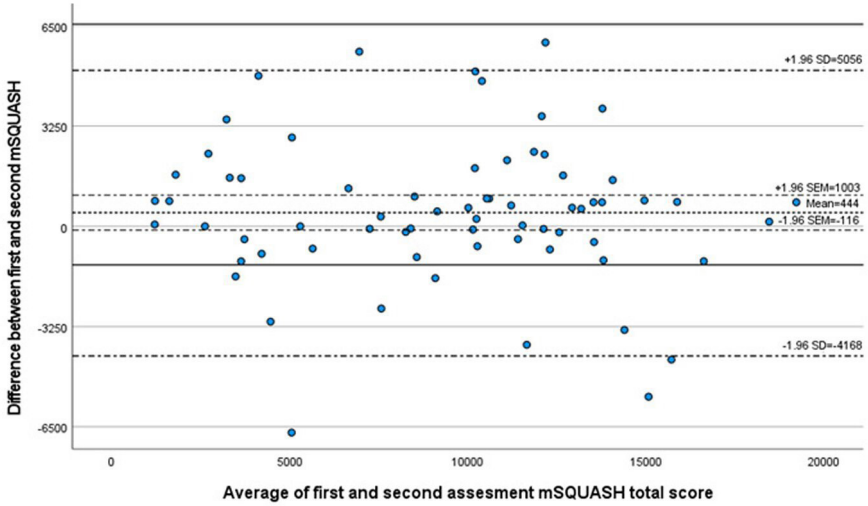

Figure 3 Test–retest reliability: Bland-Altman plot of mSQUASH total activity score. mSQUASH, modified Short QUestionnaire to ASsess Health-enhancing physical activity.

applicable to diverse regions. The expectation is that these changes enhance the cross-cultural applicability of the mSQUASH, rendering it also suitable for use in other countries.

The clinical validation of the English version confirmed the good measurement properties of the original Dutch version of the mSQUASH. The construct validity of the mSQUASH total activity scores demonstrated fair correlations with assessments of disease activity, physical function and overall functioning and health (ranging from −0.25 to −0.37), aligning with our hypothesis that these instruments assess related but distinct constructs. Again, correlations were comparable to the Dutch study (ranging from −0.26 to −0.40).[11] The English mSQUASH demonstrated very good test–retest reliability with an ICC of 0.87 for total activity score, reinforcing its consistency in repeated measurements at group level. The reliability of the individual domains varied from fair reliability for commuting activities to very good for work or school/study activities. The lowest ICC of 0.42 for the commute domain raises considerations, especially compared with the Dutch mSQUASH ICC of 0.64.[11] This difference is probably also related to the distinct commuting behaviours in the USA, where car-dependent travel is more common due to longer distances. Given that ICC is influenced by the variability within the observed data, the finding that only half of the included participants engaged in walking or cycling for their commute had a substantial impact on the ICC calculation. The responsiveness of the English mSQUASH over a 3-month period further reinforces its utility. The SRM of the mSQUASH total activity score aligned with the direction of self-reported changes in physical activity, supporting the questionnaire's sensitivity to change at group level, with SRM values of 0.72 for improved, 0.06 for stable and −0.74 decreased activity levels. Again, these findings are very similar to the responsiveness of the Dutch mSQUASH version (SRM improvement of 0.84 and worsening of 0.88).[11] However, the 95% LOAs were wide for the mSQUASH total activity scores in the Bland-Altman plot, indicating that only large changes can be considered true changes at individual patient level. Further studies in larger samples will be needed to determine the minimum clinically important difference. In the current study, we did not repeat the assessment of criterion validity compared with the accelerometer. However, given the consistency observed in construct validity, test–retest reliability and responsiveness, we anticipate comparability with the validation study of the Dutch version of the mSQUASH, in which we found a correlation of 0.57 between mSQUASH (total activity score) and accelerometer (kilocounts/day).[11]

Table 3 Responsiveness: SRM using the Anchor method for self-reported improvement, stability and worsening of physical activity

	Baseline	3 months	SRM	95% CI
mSQUASH				
Improved physical activity	9139 (3937)	11 082 (3520)	0.72	0.21, 1,24
Stable physical activity	8873 (4649)	9035 (4850)	0.06	−0.25, 0.36
Decreased physical activity	10 876 (5033)	7835 (3668)	−0.74	−1.32, 0.16

Values are presented in mean (SD).
mSQUASH, modified-Short Questionnaire to ASsess Health-enhancing physical activity; SRM, standardised response mean.

With the mSQUASH, healthcare professionals (HCPs) can obtain a detailed insight into the type of physical activity routines. Adding the answer option 'not applicable' facilitates efficient navigation through all the different domains, achieving a complete understanding of the individual's activities. This is in line with overarching principles of the 2021 EULAR recommendations, which emphasise lifestyle improvements as an essential aspect of management, contributing to overall health benefits in patients with RMDs.[1] The WHO physical activity guidelines emphasise the importance of performing both aerobic activities and muscle strength exercises.[29] The mSQUASH allows HCPs to identify the specific domains in which physical activity occurs and pinpoints areas for improvement in daily life. This level of detail enables a more targeted and personalised approach to advice and interventions compared with physical activity monitoring apps. HCPs should also acknowledge barriers to initiating and sustaining exercise, including time constraints, resource limitations, lack of motivation and disease-specific challenges.[30] Enhancing exercise habits can be attained by ensuring that the intervention incorporates behaviour change guidance. This involves providing training to therapists on customising and implementing exercise programmes while offering behaviour change support. Promoting group exercise participation can also serve as a motivational factor.[31]

It is important to acknowledge challenges within the mSQUASH. Objective data from accelerometers indicate a propensity for all physical activity questionnaires, including the mSQUASH and IPAQ, to overestimate the intensity of physical activity, consistent with findings in various studies across diverse populations.[9–11 32 33] This overestimation, a recurring phenomenon in self-reported physical activity assessments, introduces a potential bias when interpreting results. One explanation is individuals' inclination to offer socially desirable answers in questionnaires, impacting the perceived intensity of their physical activities.[34] In clinical practice, the mSQUASH can give a quick and complete overview of all types of physical activity performed by the patients. An extensive syntax is needed for the calculation of the mSQUASH total activity score and domain scores, which is more suitable for research purposes. To enhance clinical usability, in future studies, an app or online tool should be developed with an embedded algorithm that simplifies scoring and which will give a quick insight into domain and total scores. Until then, the questionnaire itself remains valuable in clinical practice, offering clinicians a practical tool to understand and discuss patients' activity levels in different domains without detailed scoring.

Our axSpA study was conducted in San Francisco, a city with an overall active lifestyle and health-conscious culture, which may have introduced selection bias. However, this urban environment has enabled us to capture a diverse spectrum of physical engagement, enhancing the questionnaire's adaptability to varied lifestyles. Additionally, our study only included patients from UCSF Health, a renowned healthcare facility. This may introduce socioeconomic and health bias, as these patients likely have better access to healthcare resources and higher health consciousness. This may explain some floor effect in the results of the construct validity in the clinical assessments. A relatively large proportion of patients scored 0 on BASFI and ASAS-HI, signifying an absence of functional impairment, and indicating good overall functioning and health. Because patients were seen in a specialty spondyloarthritis clinic in a tertiary and quaternary referral centre, there might be selection for more difficult to manage patients. Despite this potential limitation, the heightened health awareness among participants can be viewed as an asset, facilitating a more robust evaluation of the mSQUASH in a population actively seeking and valuing healthcare guidance.

One notable strength of our study lies in the inclusion of diverse groups of patients with rheumatic diseases including axSpA, SjD, SLE and GCA/PMR, encompassing a broad range of characteristics, allowing for a more comprehensive understanding of how the mSQUASH performs across varied demographic and clinical profiles. Based on this field testing, the mSQUASH's usability extends beyond its initial application in axSpA. The clinical validation in axSpA patients from the USA confirmed the good measurement properties found in the development and validation study in axSpA patients from the Netherlands. Recently, translation and field testing of the mSQUASH were performed in Spain, Turkey, Germany and France, which was aligned with the current final version of the mSQUASH.[35–38] Future studies translating and cross-cultural adapting the English mSQUASH into different languages and countries will further support world-wide distribution, applicability and comparability of physical activity research.

CONCLUSION

The mSQUASH is a feasible, easily applicable and valid questionnaire to uniformly assess the amount and type of daily physical activity. The mSQUASH showed good linguistic and face validity according to field testing in different rheumatic diseases. Clinical validation confirmed good validity, test–retest reliability and responsiveness in axSpA patients, which supports the use of the mSQUASH in clinical practice and research, also in other rheumatic diseases.

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Ethics approval The axSpA study cohort and an amendment for the present study were approved by the Institutional Review Board at UCSF (10-01694). For the field testing in the other rheumatic diseases, the Medical Ethics Review Board of the UMCG (2022.581) has considered that the research does not fall within the scope of the Medical Research Involving Human Subjects Act (non-WMO).

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